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Dioxin, Dibenzofuran, and PCB Congeners in Cooked and Uncooked Foods

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Abstract

Food, especially meat, fish, and dairy products, constitutes the primary proximate source of dioxins (PCDDs), dibenzofurans (PCDFs) and PCBs for the general population. However, most data on the levels of these chemicals in food is for food in the raw (uncooked) state. This study continues our work studying the effect of one type of cooking (broiling) on the levels of PCDDs, PCDFs, and PCBs in hamburger (ground beef), beefsteak, bacon, chicken, trout and catfish. In order to measure changes in the amounts of dioxins in consumed food, meat and fish samples were broiled and compared to uncooked samples. For the hamburger, bacon, and catfish, the total PCDD/PCDF/co-planar PCB TEQ decreased by approximately 50% on average as a result of broiling. However, the concentration (pg TEQ/kg) of PCDDs, PCDFs, and co-planar PCBs remained the same in the hamburger, increased by 84% in the bacon, and decreased by 34% in the catfish.

Introduction

A number of studies of polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and polychlorinated biphenyls (PCBs) in food have examined the levels of PCDDs, PCDFs, and PCBs in uncooked foods from the United States, Canada, Germany, and several other countries[1,2,3,4,5,6]. However, few studies have included cooked food or considered the impact that cooking has on dioxin levels in foods[7]. This study extends our previous on the effect that broiling has on the levels and dioxin toxic equivalents (TEQs) of PCDDs, PCDFs, and PCBs in various types of meat and fish.

Methods

Ground beef, beefsteak, bacon, chicken, trout and catfish were purchased from a supermarket in

Binghamton, New York. Each food type was divided into nine samples of approximately 200 grams each. For each type of food, five samples were broiled thoroughly in an electric oven, while four were left raw to serve as uncooked controls. Samples were weighed before and after cooking. One of the cooked samples from each food type was consumed to ensure edibility. The eight remaining samples of each of the six types of food were then labeled, frozen and shipped on dry ice to ERGO Forschungsgesellschaft mbH, a World Health Organization certified laboratory, for dioxin analyses. Analytic methods have previously been described and will not be presented here[8,9].

Results

Figure 1 displays the percent change in weight, concentration (picograms [pg] TEQ/kilogram [kg]) of PCDDs, PCDFs, and PCBs, and pg TEQ of PCDDs/PCDFs/PCBs per sample for hamburger, bacon, and catfish. As expected, broiling caused the weight to decrease in all three food types. The decrease in weight ranged from 36% for catfish to 75% for bacon. Likewise, the total amount of pg TEQ for PCDDs, PCDFs and co-planar PCBs decreased by approximately 50% in all three food types. However, on average, the concentration (pg TEQ/kg) of PCDDs, PCDFs, and co-planar PCBs remained the same in the hamburger, increased by 84% in the bacon, and decreased by 34% in the catfish. Figure 2 shows the total level of PCDDs, PCDFs, and co-planar PCBs in pg TEQ/kg, on average, for the raw samples vs. the cooked ones. Levels for hamburger remained unchanged at about 155 pg TEQ/kg. For bacon the level increased from 79 pg TEQ/kg to 145 pg TEQ/kg. The levels in catfish decreased from 577 pg TEQ/kg to 378 pg TEQ/kg.

Discussion and Conclusions

For the samples presented in this abstract, on a per sample basis, the total amount of pg TEQ for PCDDs, PCDFs, and co-planar PCBs decreased on average by approximately 50%. On a per kilogram basis, the pg TEQ of PCDDs, PCDFs, and PCBs in uncooked food may increase, decrease, or remain the same after broiling, depending on the type of meat or fish involved. Therefore, the pg TEQ/kg of PCDDs, PCDFs, and PCBs in uncooked food does not accurately predict the pg TEQ/kg of PCDDs/PCDFs/PCBs in the same food after broiling. Different methods of cooking may lead to different results. Thus, previous estimates of intake of PCDDs, PCDFs, and PCBs from food which were based on uncooked food measurements may have overestimated or underestimated daily dietary intake. Further investigation on the effects of cooking methods on foods is indicated to provide accurate estimates of PCDD/PCDF/PCB intake from cooked food. Analytic data from all 6 food types is currently complete.

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Figure I: PCDD/F/PCB Percent Change in Cooked Food

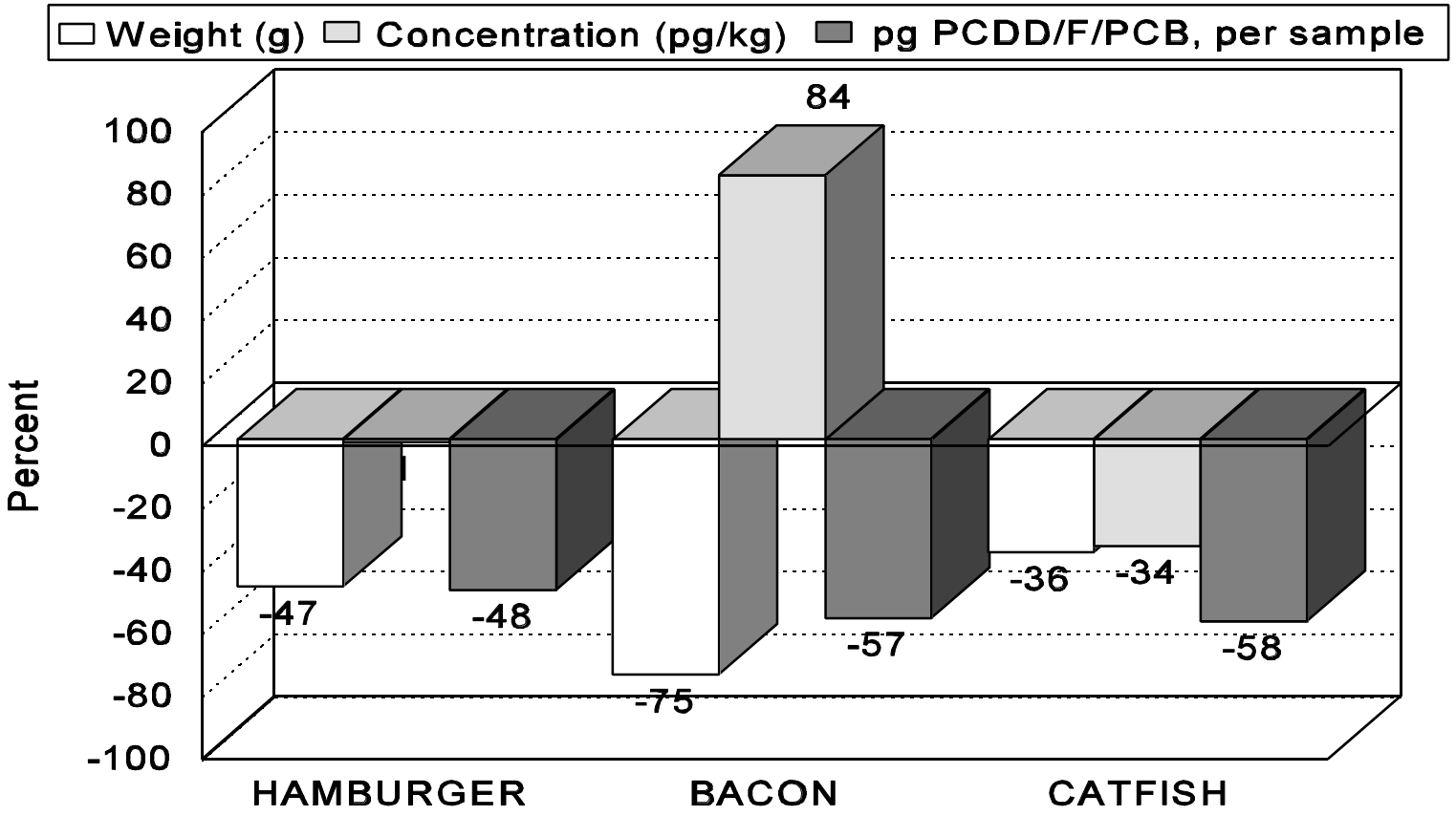

Figure II: Changes in PCDD/F/PCB Concentration from Cooking (Broiling) Food (wet weight)